EURO NCAP

#FORSAFERVANS

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May 2025

Crash Avoidance
Low Speed Collisions

Protocol

Implementation January 2026

PREFACE

During the test preparation, vehicle manufacturers are encouraged to liaise with the laboratory and to check that they are satisfied with the way cars are set up for testing. Where a manufacturer feels that a particular item should be altered, they should ask the laboratory staff to make any necessary changes. Manufacturers are forbidden from making changes to any parameter that will influence the test, such as dummy positioning, vehicle setting, laboratory environment etc.

It is the responsibility of the test laboratory to ensure that any requested changes satisfy the requirements of Euro NCAP. Where a disagreement exists between the laboratory and manufacturer, the Euro NCAP secretariat should be informed immediately to pass final judgment. Where the laboratory staff suspect that a manufacturer has interfered with any of the set up, the manufacturer's representative should be warned that they are not allowed to do so themselves. They should also be informed that if another incident occurs, they will be asked to leave the test site.

Where there is a recurrence of the problem, the manufacturer's representative will be told to leave the test site and the Secretary General should be immediately informed. Any such incident may be reported by the Secretary General to the manufacturer and the person concerned may not be allowed to attend further Euro NCAP tests.

DISCLAIMER: Euro NCAP has taken all reasonable care to ensure that the information published in this protocol is accurate and reflects the technical decisions taken by the organisation. In the unlikely event that this protocol contains a typographical error or any other inaccuracy, Euro NCAP reserves the right to make corrections and determine the assessment and subsequent result of the affected requirement(s).

CONTENTS

DEFINITIONS

Throughout this protocol the following terms are used:

Start from Stop (SfS) – a test condition in which the VUT starts moving off from standstill.

Peak Braking Coefficient (PBC) – the measure of tyre to road surface friction based on the maximum deceleration of a rolling tyre, measured using the method as specified in UNECE R13-H.

Autonomous Emergency Braking (AEB) – braking that is applied automatically by the vehicle in response to the detection of a likely collision to reduce the vehicle speed and potentially avoid the collision.

Door Opening Warning (DOW) – an audio-visual warning that is provided automatically by the vehicle in response to the detection of a likely dooring collision with a passing bicyclist.

Vehicle width – the widest point of the vehicle ignoring the rear-view mirrors, side marker lamps, tyre pressure indicators, direction indicator lamps, position lamps, flexible mud-guards and the deflected part of the tyre side-walls immediately above the point of contact with the ground.

Van-to-Pedestrian – a collision between a vehicle and an adult or child pedestrian in its path, when no braking and/or steering action is applied.

Van-to-Bicyclist – a collision between a vehicle and an adult bicyclist in its path, when no braking and/or steering is applied.

Vehicle under test (VUT) – means the vehicle tested according to this protocol with a pre-crash collision mitigation or avoidance system on board.

Euro NCAP Pedestrian Target (EPTa) – means the articulated adult pedestrian target used in this protocol as specified in ISO 19206-2:2018

Euro NCAP Child Target (EPTc) – means the articulated child pedestrian target used in this protocol as specified in ISO 19206-2:2018

Euro NCAP Bicyclist Target (EBTa) – means the adult bicyclist and bike target used in this protocol as specified in ISO 19206-4:2020

Global Vehicle Target (GVT) – means the vehicle target used in this protocol as defined in ISO 19206-3:2021

Time To Collision (TTC) – means the remaining time before the VUT strikes the test target, assuming that the VUT and test target would continue to travel with the speed it is travelling.

T_{AEB} – means the time where the AEB system activates. Activation time is determined by identifying the last data point where the filtered acceleration signal is below -1 m/s^2, and then going back to the point in time where the acceleration first crossed -0.3 m/s^2

T_{FCW} – means the time where the audible warning of the FCW starts. The starting point is determined by audible recognition.

V_{impact} – means the speed at which the profiled line around the front or rear end of the VUT coincides with the virtual box around the test targets (platform not included in the virtual box) EPTa, EPTc, EBTa and EMT as shown in the right part of the figures below.

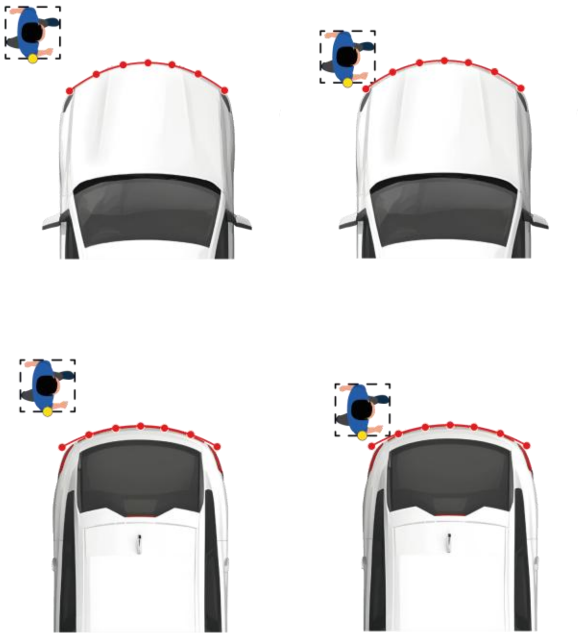

Figure 0-1 Front and rear end profile vs EPT target

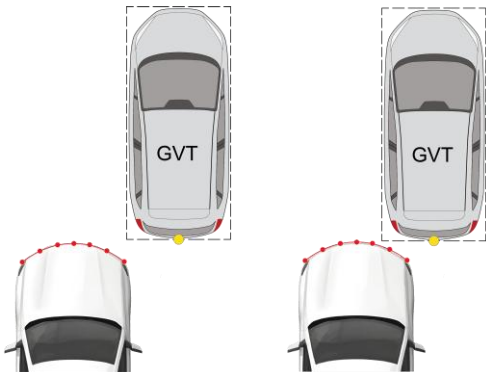

Figure 0-2 Front end profile and GVT

Test Scenarios

Van-to-Bicyclist Dooring Adult (VBDA) – a collision between the vehicle's door (or an occupant exiting a vehicle equipped with a sliding door) and a bicyclist traveling alongside the parked vehicle.

Van-to-Car Crossing Straight Crossing Path, Start from Stop (VCCscp SfS) – a collision in which a vehicle moves off from standstill condition along a straight path across a junction, towards a vehicle crossing the junction on a perpendicular path. The frontal structure of the vehicle under test strikes the side of the other vehicle.

Van-to-Pedestrian Manoeuvring Reverse Adult/Child VPMRA/C – a collision in which a vehicle travels rearwards towards an adult or child pedestrian, stationary or crossing its path walking from the nearside. The rear structure of the vehicle strikes the pedestrian at 25, 50 or 75% of the vehicle's width when no braking action is applied.

1 MEASURING EQUIPMENT

1.1 Reference system

Use the convention specified in ISO 8855:2011, with the origin at the most forward point on the centreline of the VUT for dynamic data measurements as shown in Figure 1-1. This reference system should be used for both left- and right-hand drive vehicles. In Figure 1-1 nearside and far-side are shown for a left-hand drive vehicle. For a right-hand drive vehicle, nearside and far-side are swapped.

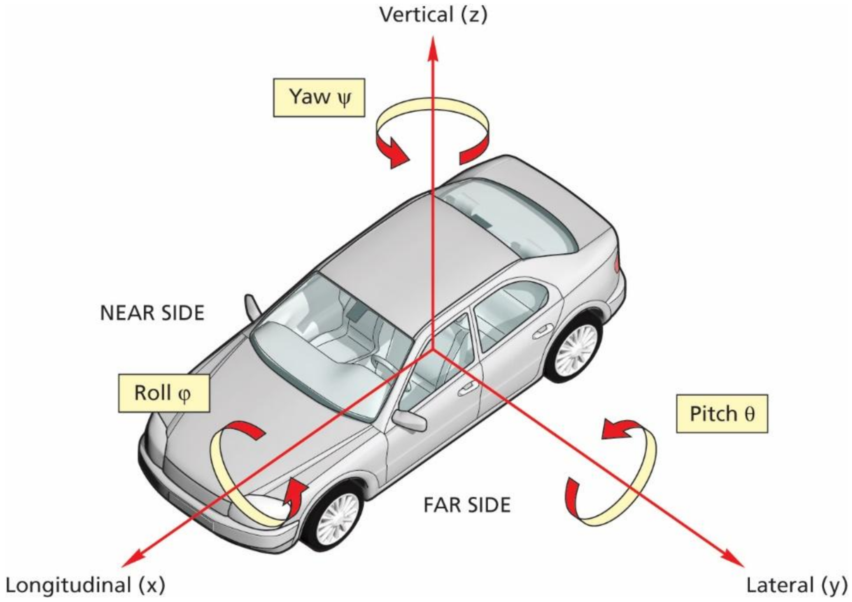

Figure 1-1 Coordinate system and notation

1.2 Targets

Only equipment listed in the current version of TB029 - Suppliers List may be used for testing. The current version can be found on the Euro NCAP website.

1.2.1 Virtual Boxes

For each test target, a virtual box defined will be used to determine the impact speed. The dimensions of these virtual boxes are shown in the figures below, along with impact reference points related to each test target.

Impact location descriptions in Chapter 3.1.2 and scenario descriptions in Chapter 5 illustrate which of the reference points is to be utilised for each specific scenario.

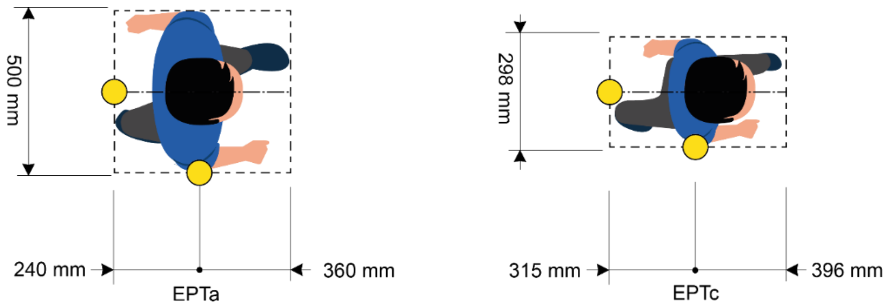

Figure 1.2.1: Virtual box dimensions around EPTa and EPTc

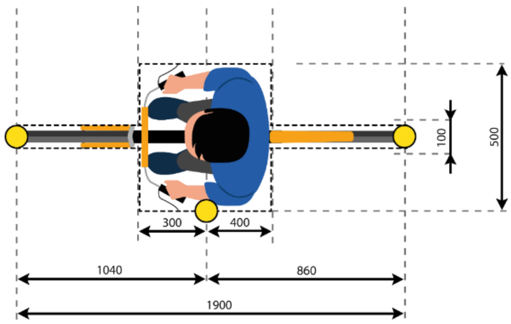

Figure 1.2.2: Virtual box dimensions around EBT

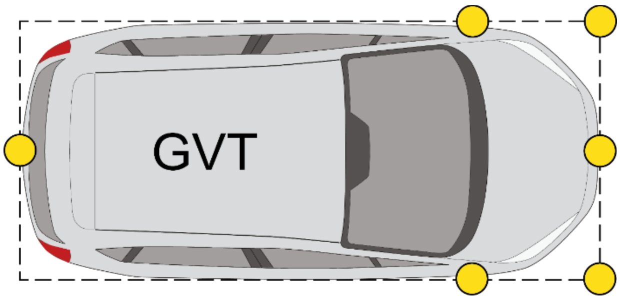

Figure 1.2.4: Virtual box illustration around the GVT, and the rear impact point

1.3 Measurements and variables

Sample and record all dynamic data at a frequency of at least 100Hz. Synchronise using the DGPS time stamp the GVT data with that of the VUT.

1.3.1 Variables

Variable	Description
T	Time
T_0	Time of test start T_0 = TTC 4s, unless stated otherwise - Crossing scenarios: T_0 = 0.5s after target acceleration phase
T_{AEB}	Time where AEB activates
T_{FCW}	Time where FCW activates
T_{impact}	Time where the VUT impacts the target
T_{Start}	Time where the VUT starts moving
T_{End}	Time where the VUT has travelled 2.9m from the start position
T_{Avg}	Time average value of T_{End} from all the executed trials
V_{impact}	Speed when the VUT impacts the target
V_{rel_impact}	Relative speed when the VUT impacts the target
X_{VUT}, Y_{VUT}	Position of the VUT during the entire test
V_{VUT}	Speed of the VUT during the entire test
A_{VUT}	Acceleration of the VUT during the entire test
$\dot{\Psi}_{VUT}$	Yaw velocity of the VUT during the entire test
Ω_{VUT}	Steering wheel velocity of the VUT during the entire test
X_{target}, Y_{target}	Position of the target during the entire test
V_{target}	Speed of the target during the entire test
A_{target}	Acceleration of the target during the entire test
$\dot{\Psi}_{target}$	Yaw velocity of the target during the entire test

1.3.2 Measurements

Equip the VUT and GVT with data measurement and acquisition equipment to sample and record data with an accuracy of at least:

- VUT and target speed to 0.1km/h
- VUT and target lateral and longitudinal position to 0.03m
- VUT heading angle to 0.1°
- VUT and target yaw rate to 0.1°/s
- VUT and target longitudinal acceleration to 0.1m/s^2
- VUT steering wheel velocity to 1.0 °/s

1.3.3 Filtering

Filter the measured data as follows:

- Position and speed are not filtered and are used in their raw state.
- Acceleration, yaw rate, steering wheel velocity and force are filtered with a 12-pole phase less Butterworth filter with a cut off frequency of 10Hz.

2 TEST CONDITIONS

2.1 Test track

Conduct tests on a dry (no visible moisture on the surface), uniform, solid paved surface with a maximum longitudinal slope of ±1% and a maximum lateral slope of ±3%. The test surface shall have a minimal peak braking coefficient (PBC) of 0.9.

The test track surface must be paved and may not contain irregularities (e.g. large dips or cracks, manhole covers or reflective studs) that may give rise to abnormal sensor measurements within a lateral distance of 5.0m to either side of the test path, and with a longitudinal distance of 20m ahead of the VUT when the test ends.

Unless otherwise specified:

Conduct testing such that, between T_0 and the test end, there are no other vehicles, infrastructure (except lighting columns during the low ambient lighting condition tests), obstructions, other objects or persons which may give rise to abnormal sensor measurements within the visual axis of the VUT and test target, and 20m ahead of the VUT at test end.

The general view ahead and to either side of the test area shall not comprise of any highly reflective surfaces or contain any silhouettes similar in shape to the test target.

2.2 Lane Markings

The presence of lane markings is allowed for AEB tests. However, testing may only be conducted in an area where typical road markings depicting a driving lane may not be parallel to the test path within 3.0m either side. Lines or markings may cross the test path but may not be present in the area where AEB activation and/or braking after FCW is expected.

Some scenarios described in this document require the use of a junction, where this is the case the scenario description will illustrate the scenario on a junction as in Figure 4.2. The main approach lane where the VUT path starts, (horizontal lanes in Figure 4.2) will have a width of 3.5m. The side lane (vertical lanes in Figure 4.2) will have a width of 3.25 to 3.5m. The lane markings on these lanes need to conform to one of the lane markings as defined in UNECE Regulation 130:

1. Dashed line starting at the same point where the radius transitions into a straight line with a width between 0.10 and 0.15m
2. Solid line with a width between 0.10 and 0.25m
3. Junction without any central markings

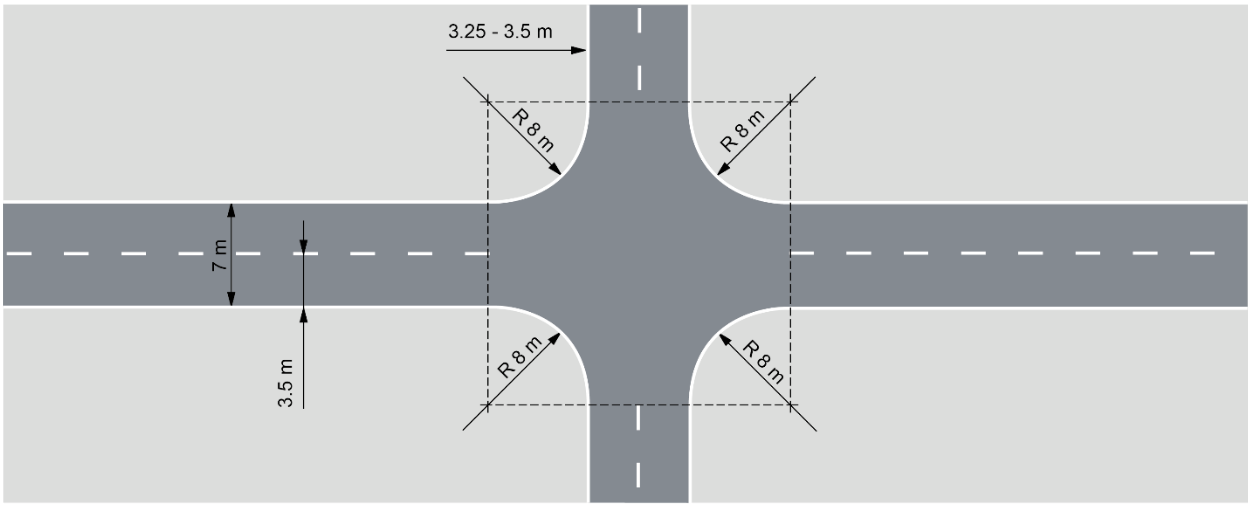

Figure 4.2: Layout of junction and the connecting lanes

(Dimensions reference centre of lane markings)

2.3 Weather Conditions

Unless otherwise specified:

Conduct tests in dry conditions with ambient temperature above 5°C and below 40°C.

No precipitation shall be falling and horizontal visibility at ground level shall be greater than 1km. Wind speeds shall be below 10m/s to minimise GVT and VUT disturbance.

Natural ambient illumination must be homogenous in the test area and in excess of 2000 lux for daylight testing with no strong shadows cast across the test area other than those caused by the VUT or GVT. Ensure testing is not performed driving towards, or away from the sun when there is direct sunlight.

Measure and record the following parameters preferably at the commencement of every single test or at least every 30 minutes:

a) Ambient temperature in °C;
b) Track Temperature in °C;
c) Wind speed and direction in m/s;
d) Ambient illumination in Lux.

2.4 VUT Preparation

2.4.1 AEB and FCW System Settings

Set any driver configurable elements of the AEB and/or FCW system (e.g. the timing of the collision warning or the braking application if present) to the middle setting or midpoint and then next latest setting similar to the examples shown in Figure 4.4.

When the vehicle is equipped with a Driver State Monitoring (DSM) which alters the AEB and/or FCW sensitivity according to the driver's state (e.g. distracted / attentive), this system shall be deactivated before the testing commences.

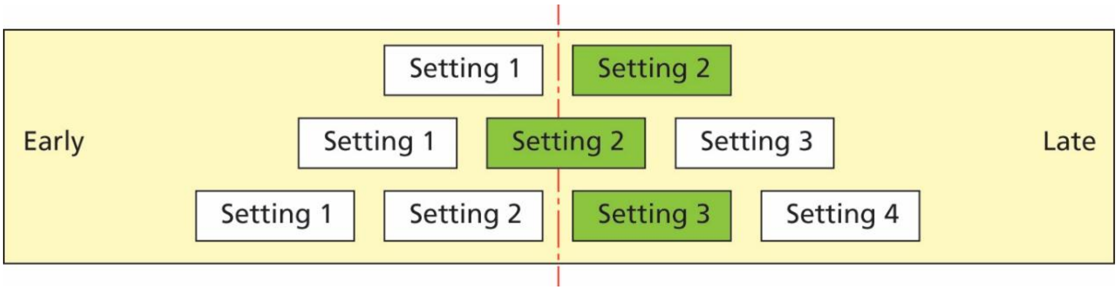

Figure 4.4: AEB and/or FCW system setting for testing

2.4.2 Deployable Pedestrian/VRU Protection Systems

When the vehicle is equipped with a deployable pedestrian/VRU protection system, this system shall be deactivated before the testing commences.

2.4.3 Tyres

Perform the testing with new original fitment tyres of the make, model, size, speed and load rating as specified by the vehicle manufacturer. It is permitted to change the tyres which are supplied by the manufacturer or acquired at an official dealer representing the manufacturer if those tyres are identical make, model, size, speed and load rating to the original fitment. Inflate the tyres to the vehicle manufacturer's recommended cold tyre inflation pressure(s). Use inflation pressures corresponding to least loading normal condition.

Run-in tyres according to the tyre conditioning procedure specified in 2.4.3. After running-in maintain the run-in tyres in the same position on the vehicle for the duration of the testing.

2.4.4 Wheel Alignment Measurement

The vehicle should be subject to a vehicle (in-line) geometry check to record the wheel alignment set by the OEM. This should be done with the vehicle in kerb weight.

2.4.5 Vehicle loading

Complete testing with the vehicle half laden to represent typical N1 operation, with 'as tested' mass as follows:

$$As\ tested\ mass\ =\ Test\ ready\ mass\ +\ ((GVW - Test\ ready\ mass)/2)$$

With 'test ready' mass being:

$$Test\ ready\ mass\ =\ Unladen\ kerb\ mass\ +\ Interior\ load$$

And with ‘interior load’ being:

$$Interior\ load\ =200kg\ =Driver\ +\ test\ equipment\ +\ additional\ required\ ballast$$

The procedure to prepare the van for the load requirements will be followed according to below steps:

a. Fill up the tank with fuel to at least 90% of the tank’s capacity of fuel.
b. Check the oil level and top up to its maximum level if necessary. Similarly, top up the levels of all other fluids to their maximum levels if necessary.
c. Ensure that the vehicle has its spare wheel on board, if fitted, along with any tools supplied with the vehicle. Nothing else should be in the van.
d. Ensure that all tyres are inflated according to the manufacturer’s instructions for the appropriate loading condition.
e. Measure the front and rear axle masses and determine the total mass of the vehicle. The total mass is the ‘unladen kerb mass’ of the vehicle. Record this mass in the test details.
f. Fit the test equipment in the vehicle (i.e. on-board test equipment and instrumentation , associated cables, cabling boxes and power sources).
g. With the driver and test equipment in the vehicle, weigh the vehicle. Record the driver + test equipment mass by subtracting the new measured mass to the initially measured unladen kerb mass.
h. Calculate the 'additional required ballast’ by subtracting the mass of the driver and test equipment from the required 200kg interior load.
i. If applicable, place weights with a mass of the ‘additional required ballast’. Any items added should be securely attached to the interior of the vehicle.
j. Compare these loads with the ‘unladen kerb mass’.
k. Add additional ballast in the cargo space to increase the ‘test ready’ mass to ‘as tested’ mass, with an overall tolerance of ±1%. Locate the centre of mass of the ballast centrally within the cargo space (longitudinally, laterally and vertically) as far as is as practically possible. If the vertical limit of the cargo space is undefined (e.g. in the case of a flatbed or tipping body) locate the centre of mass of the ballast [0.6]m above the load bed. Ballast must be securely attached to the VUT. If water is used as ballast, it should be used in full containers to prevent the movement under acceleration.
l. Note the ‘as tested’ front/rear axle load distribution may not necessarily remain within 5% of the front/rear axle load distribution of the original ‘unladen kerb mass’, which is acceptable for this testing.

Care needs to be taken when adding or removing weight in order to approximate the original vehicle inertial properties as close as possible. Record the final axle loads in the test details. Record the axle weights of the VUT in the ‘as tested’ condition.

3 TEST PROCEDURE

3.1 Car Scenarios

CAR	TOTAL 3
Crossing Van-to-Car Crossing	**3** 3

3.1.1 Van-to-Car Crossing

VCCscp	GVT speed				
	20 km/h	30 km/h	40 km/h	50 km/h	60 km/h
SfS					

The VUT is initially at standstill with an initial longitudinal distance to the impact point of 2.9m. Assume a straight-line path equivalent to the centre line of the driving lane, approaching and continuing straight ahead across a junction.

For the GVT, assume a straight-line path equivalent to the centre line of the driving lane, perpendicular to that of the VUT, travelling across the junction from the farside direction.

The scenario setup is illustrated in Figure 3-1.

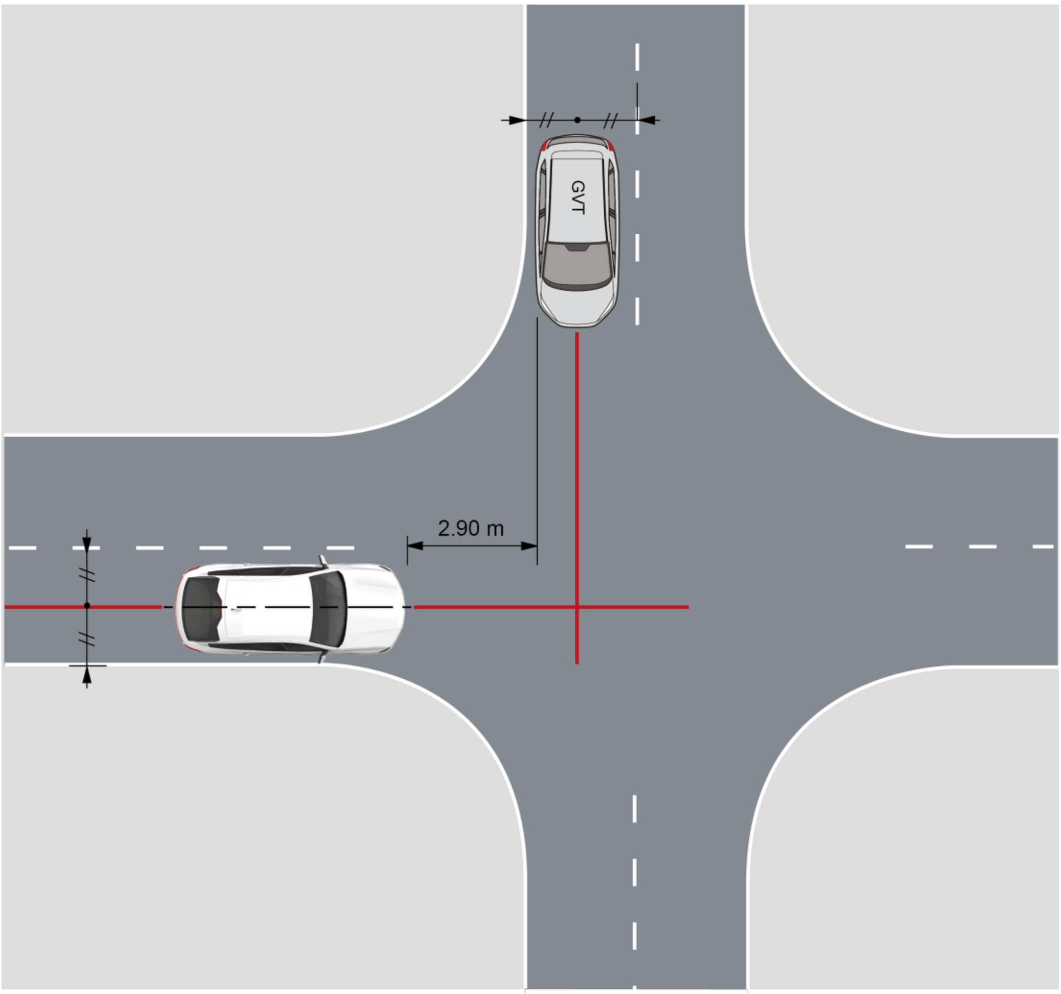

Figure 3-1 VCCscp SfS scenario setup

Apply brake pedal to ensure that VUT is stationary until T_0 condition is reached, and then conduct the Accelerator Pedal profile as described in Technical Bulletin CA 102.

The GVT shall be accelerated to the selected speed at a rate >1m/s^2 during the acceleration phase. This is followed by a 0.5 s stabilization phase, after which steady state conditions shall be met before the lower of 3.5s TTC.

The paths will be synchronised so that the front of the VUT collides with the reference point of the GVT at an impact location of 50% ±25% (assuming no system reaction).

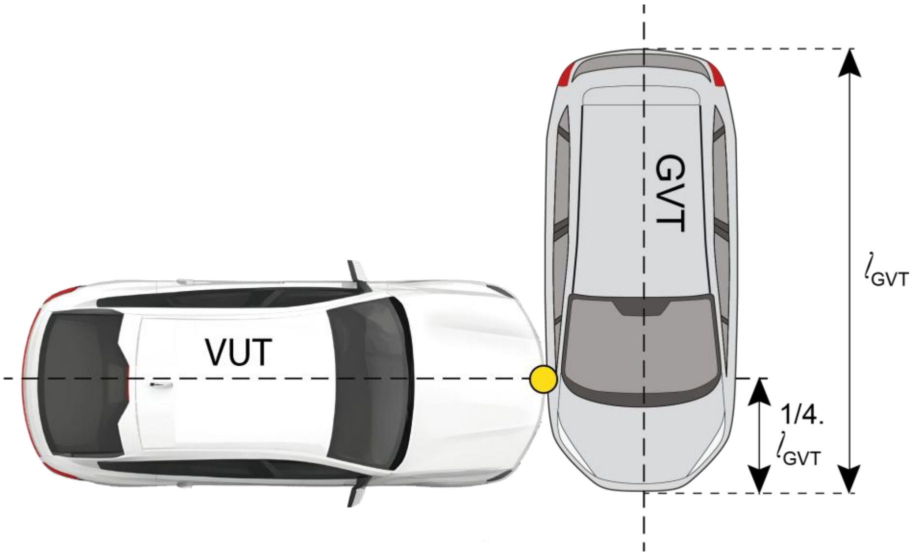

Figure 3-2 VCCscp SfS Impact location definition

3.2 Pedestrian & Cyclist Scenarios

Pedestrian & Cyclist	TOTAL 7
Manoeuvring	**4**
Van-to-Pedestrian Manoeuvring Reverse	4
Dooring	**3**
Van-to-Bicyclist Dooring	3

3.2.1 Van-to-Pedestrian Manoeuvring

3.2.1.1 VPMRC/A

In the Car-to-Pedestrian Reverse scenario, a combination of the EPTa and EPTc is used to ensure robust performance. The following table shows which of the pedestrian targets is used in the different speed and overlap combinations.

VPMRC/A	EPTa/c Speed	Target type	Impact Location		
			25%	50%	75%
4 km/h	0 km/h	EPTc	■		
4 km/h	0 km/h	EPTa		■	
4 km/h	0 km/h	EPTc			■
4 km/h	5 km/h	EPTa		■	
8 km/h	0 km/h	EPTc	■		
8 km/h	0 km/h	EPTa		■	
8 km/h	0 km/h	EPTc			■
8 km/h	5 km/h	EPTa		■	

Where the dummy is stationary (CPRA/Cs), the dummy should be used in its resting position with the articulation being switched off (i.e. not the static dummy posture as defined in ISO 19206-2).

The scenario setup is illustrated in Figure 3-3.

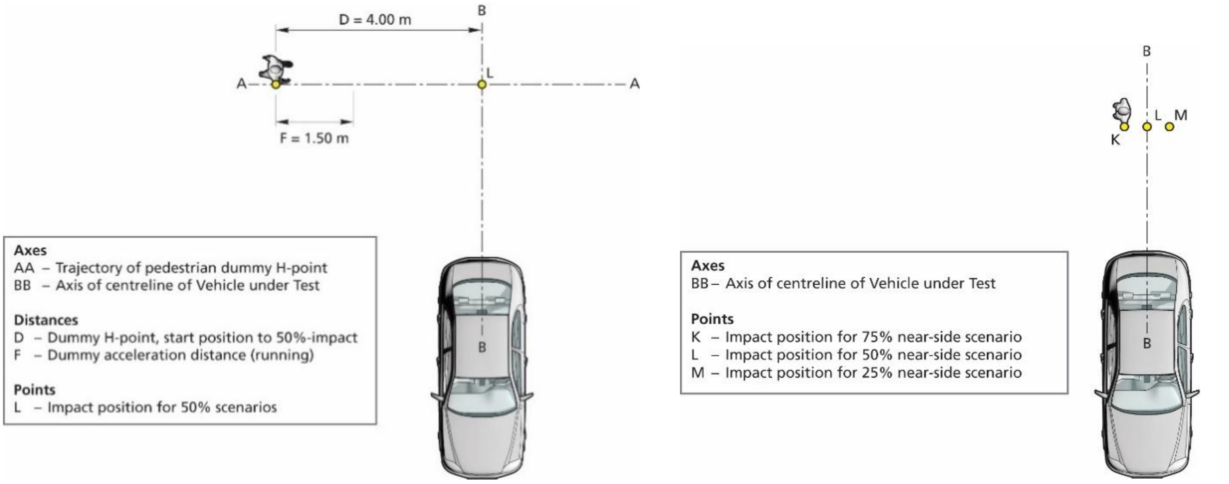

Figure 3-3 CPMRA/C scenario, Pedestrian from Nearside (left) and Stationary (right)

3.2.2 Van-to-Bicyclist Dooring

VBDA	EBT speed
Rear gap	15 km/h
2.00 m	

For the VBDA scenario, a bicycle is traveling in a straight line at 15 beside the parked vehicle. The Rear gap (distance between VUT and obstruction car) is fixed to 2.00m.

The widest outside structure (without mirrors) of VUT and obstruction car are aligned one meter from the path of the VRU while the central-axis of the cars are in parallel to VUT path. The obstruction vehicle to be used is the smaller obstruction vehicle as defined in APPENDIX A.

In the first run, the EBT passes the parking car without operation on the door opening interface to assess the information given to the driver, where applicable.
In the second run (applicable for a warning system T_{open} and for a retention system $T_{door\ operation}$), the VUT driver door opening interface shall be operated at a distance of 8 + [0.5] m, defined from the bicyclist front reference point and the most rearward point of the driver door:

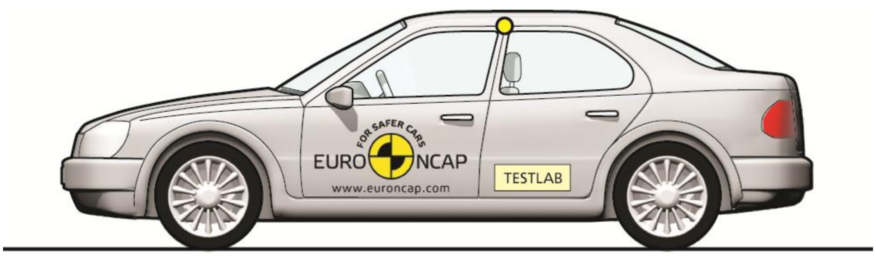

Figure 3-4 Reference point and direction relative to the VUT for dooring scenario

Door opening (manually operated):

Pull door handle or activate other door opening interface (e.g. push a button) in a manner that would open the door to exit the car in a normal non-hazard situation, while pushing the door open. Emergency exit functions are permitted where triggered by an additional action (e.g. second pull).

For VBDA, all tests shall be performed with the VUT in parking position within 60 seconds after propulsion system turned off with the driver in unbelted state.

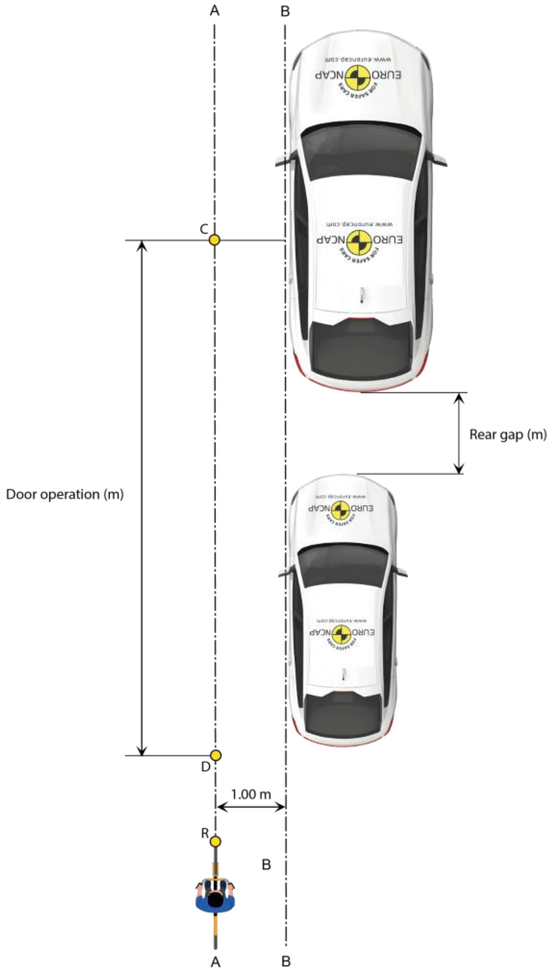

Figure 3-5 VBDA scenario setup

4 TEST EXECUTION

4.1 Performance predictions

The Vehicle Manufacturer shall provide the Euro NCAP with colour data detailing the predicted performance of the system for all test scenarios. The predicted performance will be used as a reference to identify discrepancies between the predicted results and the test results.

4.2 Verification tests

The verification tests shall be conducted by the test laboratory in all grid cells (from the grid cells where the Vehicle Manufacturer predicted performance, excluding red grid cells). A failed Verification Test in any given grid cell shall turn that grid cell into red.

In case of absence of Vehicle Manufacturer predictions, test all cases, in consultation with the Euro NCAP Secretariat – in which case, the result of each Verification Test will dictate the colour of each grid cell.

4.3 Test Conduct

4.3.1 VUT Pre-test conditioning

4.3.1.1 General

A new car is used as delivered to the test laboratory.

If requested by the vehicle manufacturer, drive a maximum of 100km on a mixture of urban and rural roads with other traffic and roadside furniture to ‘calibrate’ the sensor system. Avoid harsh acceleration and braking.

4.3.1.2 Brakes

Condition the vehicle’s brakes in the following manner, if it has not been done before or in case the lab has not performed a 100km of driving:

- Perform twenty stops from a speed of 56km/h with an average deceleration of approximately 0.5 to 0.6g.
- Immediately following the series of 56km/h stops, perform three additional stops from a speed of 72km/h, each time applying sufficient force to the pedal to operate the vehicle’s antilock braking system (ABS) for the majority of each stop.
- Immediately following the series of 72km/h stops, drive the vehicle at a speed of approximately 72km/h for five minutes to cool the brakes.

4.3.1.3 Tyres

Condition the vehicle’s tyres in the following manner to remove the mould sheen, if this has not been done before for another test or in case the lab has not performed a 100km of driving:

- Drive around a circle of 30m in diameter at a speed sufficient to generate a lateral acceleration of approximately 0.5 to 0.6g for three clockwise laps followed by three anticlockwise laps.

- Immediately following the circular driving, drive four passes at 56km/h, performing ten cycles of a sinusoidal steering input in each pass at a frequency of 1Hz and amplitude sufficient to generate a peak lateral acceleration of approximately 0.5 to 0.6g.
- Make the steering wheel amplitude of the final cycle of the final pass double that of the previous inputs.

In case of instability in the sinusoidal driving, reduce the amplitude of the steering input to an appropriately safe level and continue the four passes.

4.3.1.4 System Check

Before any testing begins, perform a maximum of ten runs at the lowest test speed the system is supposed to work, to ensure proper functioning of the system.

4.3.2 AEB tests

Accelerate the VUT and target to the respective test speeds where needed.

The test shall start at T0 and is valid when all boundary conditions are met between T_0 and T_{AEB} and/or TFCW:

<table>
<tr><th></th><th>VUT</th><th>GVT</th><th>EPT</th><th>EBT</th></tr>
<tr><td>Speed</td><td>-</td><td>± 1.0 km/h</td><td>± 0.2 km/h</td><td>± 0.5 km/h</td></tr>
<tr><td>Lateral deviation</td><td>0 ± 0.05 m</td><td>0 ± 0.10 m</td><td colspan="2">0 ± 0.05 m for crossing scenarios (incl. VPMRA/C)
0 ± 0.15 m for longitudinal scenarios</td></tr>
<tr><td>Lateral velocity</td><td></td><td>-</td><td>0 ± 0.15 m/s</td><td>0 ± 0.15 m/s</td></tr>
</table>

The end of a test, where the AEB function is assessed, is considered when one of the following occurs:

- V_{VUT} = 0km/h (crossing) or $V_{VUT} = V_{target}$ (longitudinal)
- Contact between VUT and target
- The target has left the VUT path or VUT has left the target path

It is at the test laboratory's discretion to ensure a safe testing environment. If the Vehicle Manufacturer feels the avoidance action is negatively affecting the performance of their vehicle, they should consult with the test laboratory and Euro NCAP secretariat.

5 ASSESSMENT

Each scenario in this assessment consists of a matrix with combinations of different parameters (e.g., impact location, target speed). Each combination in a matrix is referred to as grid cell.

5.1 General requirements

To be eligible for scoring points in this assessment, the following requirements shall be met:

- The system shall be default ON at the start of every journey and deactivation of the system shall not be possible with a momentary single push on a button.
- For VPMRA/C, the system may not release the brakes after an intervention, unless the threat (EPT) has left the vehicle path or in case of an override action by the driver. When the VUT is fitted as standard with a rear-view camera, the brakes may be release after 1.5s or longer after the AEB intervention.

5.2 Criteria

The following criteria and associated KPIs is used across scenarios to evaluate the performance of the system

Criteria	KPI	Scenarios	
		Car	Pedestrian & Cyclist
Avoidance	V_{impact}	VCCscp SfS	VPMRA/C
Dooring	TTC	-	VBDA

5.2.1 Avoidance

For all avoidance-only scenarios, the following criteria applies:

V_{impact} [km/h]	Colour band
0	Green
>0	Red

5.2.2 Dooring

For Van-to-Bicyclist Dooring scenario, the assessment criteria is based on the timely vehicle response upon a door opening attempt before a bicyclist is passing by. The following scaling is applied to each grid cell depending on whether the vehicle response is Information, Warning or Retention:

Vehicle response	Criteria	Doors	Colour Band
Information	TTC ≥ 2.30s	Driver's only	**Brown**
	TTC < 2.30s		**Red**
Warning	TTC ≥ 1.70s	Driver's only	**Orange**

		All	**Yellow**
	TTC < 1.70s	Driver's only OR All	**Red**
Retention	Start @ TTC ≥ 1.70s AND End @TTC ≤ -0.40s	Driver's only	**Yellow**
		All	**Green**
	Start @ TTC < 1.70s OR End @TTC > -0.40s	Driver's only OR All	**Red**

Where:

- Information shall be visually provided in the field of view of the driver's side window.
- Warning shall have a visual component (e.g., flashing) in the field of view of the driver's side window, and an audible or haptic component.
- Warning or retention functionality shall be issued on either the driver's door and/or all doors on the side where the threat is present. Reference point for all tests is the rear of the front door. Visual warning on the rear doors is not required.
- Doors that cannot endanger VRUs passing by the VUT (e.g. sliding doors that open to a small extend), Retention may be replaced by Warning and the scaling for Retention shall be used. This warning can be suppressed 10 seconds after $T_{door\ operation}$.

5.3 Scoring

For score calculation, first each grid cell is given a sub-score according to the Vehicle Manufacturer colour prediction:

Predicted Colour	Standard Range Sub-score per grid cell
Green	1.00
Yellow	0.75
Orange	0.50
Brown	0.25
Red	0.00

Secondly, the resulting score is calculated by normalizing all the scenario sub-scores to the total score of that scenario (rounded to hundredth):

$$Scenario\ Score = \frac{\sum Scenario\ Subscores\ x\ Total\ Scenario\ Score}{Number\ of\ grid\ cells\ in\ the\ scenario}$$

APPENDIX A OBSTRUCTION DIMENSIONS

B.1 Smaller obstruction vehicle

The smaller obstruction vehicle should be of the category Small Family Car and is positioned closest to the pedestrian path. The smaller obstruction vehicle should be within the following geometrical dimensions and needs to be in a dark colour.

	Vehicle length	**Vehicle width (without mirrors)**	**Vehicle height**	**Bonnet length (till A pillar)**	**BLE height**
Minimum	4100 mm	1700 mm	1300 mm	1100 mm	650 mm
Maximum	4400 mm	1900 mm	1500 mm	1500 mm	800 mm

B.2 Larger obstruction vehicle

The larger obstruction vehicle should be of the category Small SUV and is positioned behind the smaller obstruction vehicle. The larger obstruction vehicle should be within the following geometrical dimensions and needs to be in a dark colour.

	Vehicle length	**Vehicle width (without mirrors)**	**Vehicle height**
Minimum	4300 mm	1750 mm	1500 mm
Maximum	4700 mm	1900 mm	1800 mm